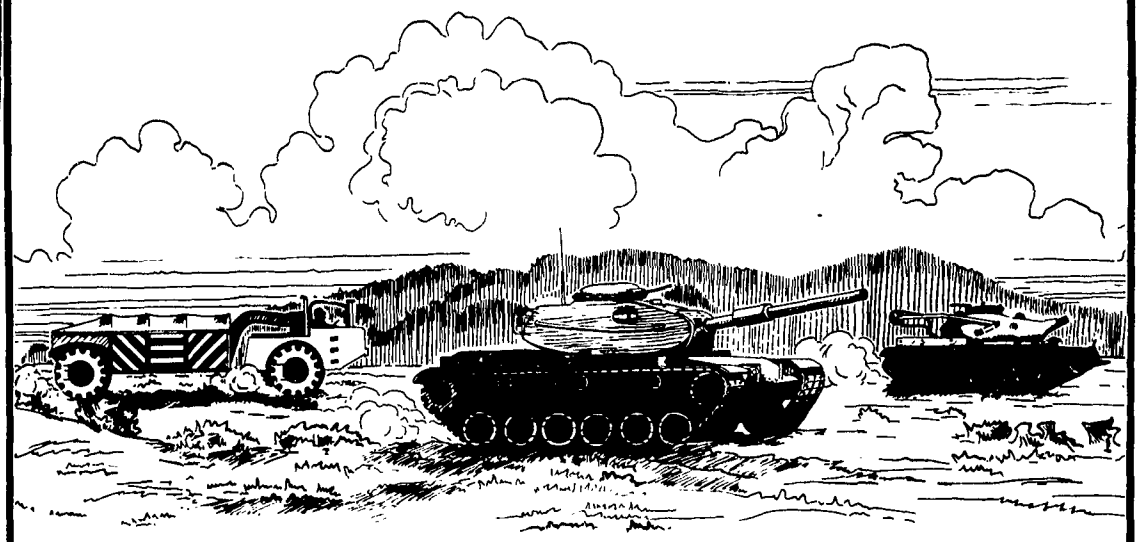
AD 297 097



US ARMY ARMOR BOARD

REPORT OF USATECOM PROJECT NO 7D-3255-01 SERVICE TEST OF CONTROLLER, DIFFERENTIAL PRESSURE, PIPELINE PUMP UNIT (DA PROJECT NO 8M53-03-001-06)

USATEC

ARM BD

HEADQUARTERS
U.S. ARMY TEST AND EVALUATION COMMAND
ABERDEEN PROVING GROUND, MARYLAND

AMSTE-GE

SUBJECT: Report of USATECOM Project No. 7D-3255-01, Service Test of Controller, Differential Pressure, Pipeline Pump Unit (DA Project No. 8M53-03-001-06)

TO: Commanding General
U. S. Army Materiel Command
ATTN: AMCRD-DE
Washington 25, D. C.

1. Two copies of the subject report are forwarded herewith.

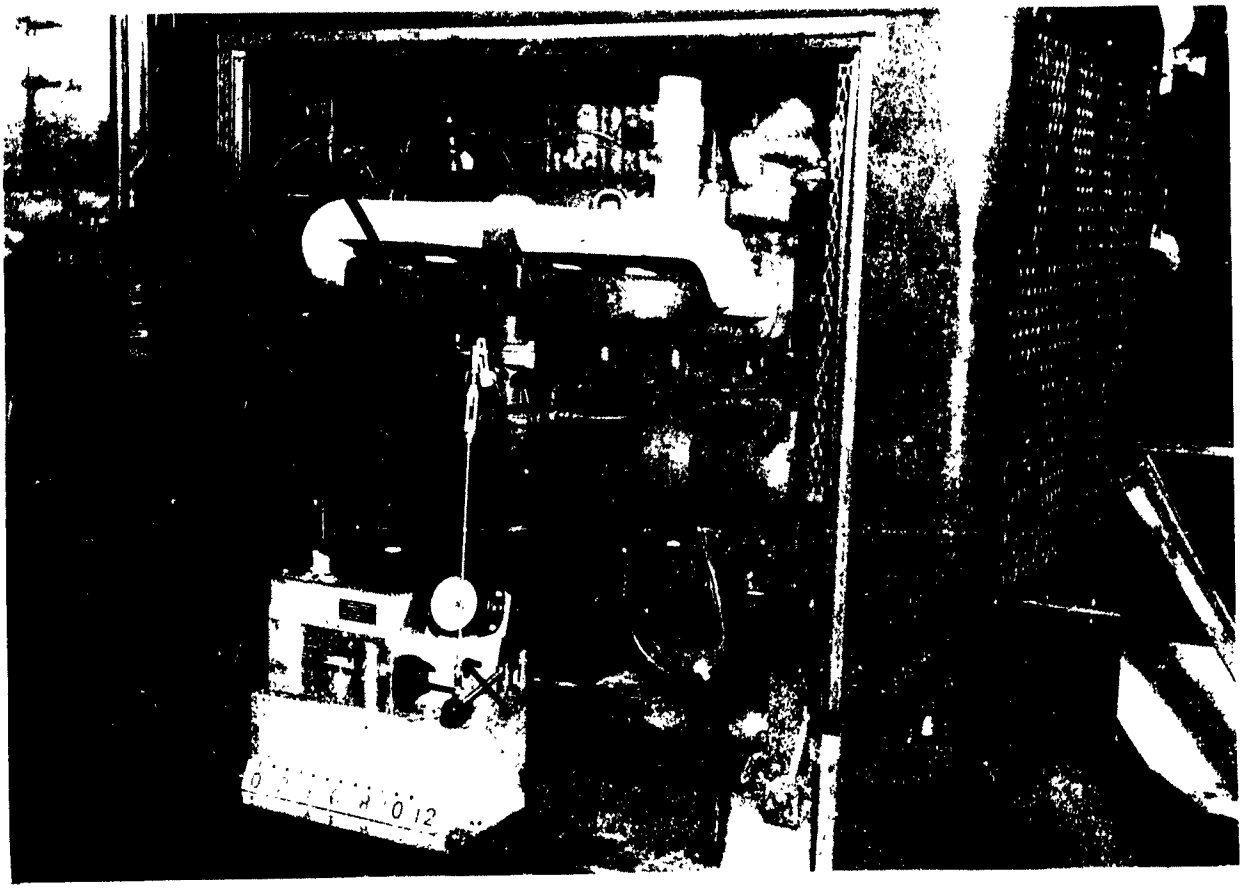
2. In view of the fact that there is no Qualitative Materiel Requirement or Small Development Requirement, it is recommended that the need for the item be reviewed. If it is determined that there is a requirement for such an item, recommend that it be modified to correct the deficiencies enumerated in the subject report and be submitted to this command for check test.

FOR THE COMMANDER:

1 Incl
(in dupe)

JOHN W. RODGERS
Colonel GS
C, Admin Div

Copies furnished:
CG, USA Mobility Command,
w/1 cy report
Pres, USA Armor Board
USATECOM Lsn Off (USAMC)
USACDC Lsn Off (USATECOM),
w/1 cy report



REPORT OF USATECOM PROJECT NO 7D-3255-01 SERVICE TEST OF CONTROLLER, DIFFERENTIAL PRESSURE, PIPELINE PUMP UNIT (DA PROJECT NO 8M53-03-001-06)

UNITED STATES ARMY ARMOR BOARD
Fort Knox, Kentucky

REPORT OF USATECOM PROJECT NO 7D-3255-01 SERVICE TEST OF CONTROLLER, DIFFERENTIAL PRESSURE, PIPELINE PUMP UNIT (DA PROJECT NO 8M53-03-001-06)

SUMMARY SHEET

1. Test Results. Nineteen test items were operated for a total of 1,182 hours at Fort Lee, Virginia and at Hachinoehe POL Storage Area, Hachinohe, Japan, and were satisfactory with respect to familiarization and training, maintenance and safety. The test items were suitable with respect to compatibility with related equipment. The test items were unsatisfactory with respect to operational performance, durability and reliability.

2. Conclusion. The item as it is now designed is unsuitable for military use.

3. Recommendations. The need for this item be reviewed and if a valid requirement for incorporation of such a device into the pipeline system exists, the item be modified to correct the deficiencies and shortcomings and be subjected to a check test.

UNITED STATES ARMY ARMOR BOARD
Fort Knox, Kentucky

1 FEB 1963

REPORT OF USATECOM PROJECT NO 7D-3255-01 SERVICE TEST OF CONTROLLER, DIFFERENTIAL PRESSURE, PIPELINE PUMP UNIT (DA PROJECT NO 8M53-03-001-06)

1. AUTHORITY.

a. Directive.

(1) Ltr, ENGRD-PP, DA, OCE, 1 Jul 61, subject: Corps of Engineers Service Test Program, FY 1962.

(2) DF, ENGRD-MS, C of Engr, 22 May 62, subject: Field Evaluation of Differential Pressure Controller for POL Pipeline Units w 1 incl.

b. Purpose. To determine the suitability of the Differential Pressure Controller for military use as an integral part of a multiunit pumping station.

2. REFERENCES.

a. US Army Engineer Research and Development Laboratories Technical Report 1698-TR, Differential-Pressure Controller for Pipeline Pump Units, 9 Nov 61.

b. US Army Engineer Test Unit Plan of Test, Service Test of Differential Pressure Controller for Pipeline Pump Units, 26 Feb 62.

3. DESCRIPTION OF MATERIEL.

a. The Differential Pressure Controller is a hydraulically-operated, pressure-sensing device, which is directly actuated by pump suction and discharge pressures. It consists basically of a spring-loaded, differential-pressure-actuated piston, which senses changes in pump differential pressure. This change of differential pressure causes immediate changes in engine speed through linkage to the engine carburetor, thus maintaining the preadjusted differential pressure. There

are two safety cutout valves which become operative and slow the engine to idling speed when the discharge operating pressure exceeds a pre-adjusted maximum or when the suction operating pressure goes below a preset minimum.

b. A maintenance package for the test item was not received.

4. BACKGROUND.

a. There are at present no specific requirements for a differential pressure controller for pipeline pump units. There are, however, general requirements for equipment that will improve the operation of pipeline systems.

b. When pump units are operated, slight power losses occur as the engine wears. These power losses cause the engine speed to decrease. To compensate for this, the amount of fuel supplied to each engine of a multiunit pump station must be increased to maintain the established differential pressure. It is known that many changes in pipeline flow (which affect system capacity) occur during operation. Some of the causes of these changes are:

(1) Different specific gravities of products being pumped

(2) Changes in product specific gravity due to ambient temperature variations

(3) Normal variations in pump characteristics requiring each pump to be operated at a different speed.

c. To protect the pumping units from extreme pressures caused by variations in the product being pumped, pressure limit switches were introduced in 1943. These switches were called "safety switches" since they stopped the pump units in case of excessively high discharge pressure, excessively low suction pressure, and extreme engine temperatures, but they did not control the operation of the pumps.

d. Two types of safety switch systems were developed. The first, an individual-unit system, was designed for use as an integral part of each individual unit; the second, a multiunit system, was an independent item for utilization with one or more pump units. The individual-unit system included design features that brought the pump unit engine to a fast idling speed prior to complete shutdown. Both systems were subjected to preliminary engineering tests, the individual-unit system performing more satisfactorily.

e. The report on these preliminary engineering tests recommended that investigation be continued to develop a control device which would provide fully automatic engine control under preset line pressure conditions. This investigation led to development of the differential pressure controller. Engineering tests were conducted under laboratory type conditions at Fort Belvoir, Virginia. These tests showed that the control units were an acceptable piece of equipment and warranted service testing (reference 2a).

f. Nineteen Santa Fe Manufacturing Corporation Model no A-4 differential pressure controllers were received for testing purposes at Fort Lee, Virginia. Fourteen of these units were later shipped to Japan of which eleven were tested at Hachinohe POL Storage Area.

5. SUMMARY OF TEST. Tests were conducted by Project Engineers Sp-5 Howard E. Barton and Pfc Tommy R. Plemmons, US Army Engineer Test Unit, Fort Belvoir, Virginia, at Fort Lee, Virginia, and at Hachinohe POL Storage Area, Hachinohe, Japan, utilizing the plan of test referenced in paragraph 2b.

a. Preoperational Inspection. The 19 test items were in satisfactory condition at Fort Lee. Nine of the 14 items, later reshipped to Japan, were received with broken regulating plug valves below the hydraulic fluid reservoir.

b. Training Requirements. Training time for qualified pump operators was 2 hours of instruction and 6 hours of supervised operation.

c. Operational Performance.

(1) The test item was suitable with respect to protecting the pump from operating when pipeline pressures are too high or too low, and in preventing the pump from operating under conditions of zero flow, which existed due to pipeline restriction or blockage.

(2) The test items were unsatisfactory with respect to maintaining a constant preset differential, preventing loss of fluids in case of line break, and preventing surging in the line.

d. Compatibility with Related Equipment. The test items were marginally adaptable to all types of pumps considered in this test.

e. Maintenance. Present plans call for unit replacement in the event of a failure. This replacement required 1 man-hour. A total of 14 man-hours was expended in first echelon maintenance and 3 man-hours for replacement of unserviceable units. This time was not considered excessive. No maintenance package or maintenance manual was furnished.

f. Durability. The 19 test items were operated for a total of 1,182 hours, an average of 62.2 hours per item. Three of the test items leaked around the pressure bellows, and all items leaked around the suction pressure cutoff adjustment. Durability and reliability were unsatisfactory.

6. DISCUSSION. A review of the Differential Pressure Controller for military pipeline units and the results obtained from the Service Test conducted on the controller raises the question as to the need for the item. The following are items to be considered in reviewing the need for the Differential Pressure Controller.

a. Manual pump adjustments are adequate to meet operational requirements for the 4-inch pipeline system.

b. The initial cost per unit is relatively high ($1,600.00).

c. The design life expectancy of the item is relatively short (500 hours).

d. Employment of the item will not eliminate any manpower requirements inasmuch as each pump station requires one man with or without the pressure controller.

7. CONCLUSION. The US Army Armor Board concludes that the Differential Pressure Controller requires modification as indicated in annex B to make it suitable for military use.

8. RECOMMENDATIONS. The US Army Armor Board recommends that:

a. The need for the Differential Pressure Controller be reviewed.

b. If a valid requirement for incorporation of such a device into the pipeline system exists, the test item be modified to correct the deficiencies and as many as practicable of the shortcomings listed in annex B and subjected to a check test.

Frank F. Carr

FRANK F. CARR
Colonel, Armor
President

ANNEXES:
A - Details of Test
B - Findings
C - Photographs and Drawings
D - Special Records

ANNEX A

DETAILS OF TEST

TEST NO 1 - PREOPERATIONAL INSPECTION

1. PURPOSE. To ensure that the test items are in proper condition for test operation.

2. METHOD.

a. Initial inspection was performed as prescribed in USA Engineer Research and Development Laboratories Technical Report 1698-TR. Repairs and adjustments were made as necessary to place the items in the best possible condition.

b. The test item was weighed, measured, and photographed.

3. RESULTS.

a. Nineteen test items were received at Fort Lee, Virginia in a satisfactory condition.

b. After transhipment to Japan, of 14 of the test items, 9 needed repairs due to broken plug valves beneath the hydraulic fluid reservoir. (See page C.2, annex C and item 11, annex B.) This repair work was accomplished by inverting the plug valves. Reserve hydraulic fluid was supplied by using an oil can when the valve was opened.

c. The test items were received in Japan minus the controller linkage connecting the unit with the engine carburetor. A connecting arm was fabricated locally (photograph C.8, annex C).

d. Pertinent physical characteristics are:

(1) Length - 16"

(2) Height - 18"

(3) Depth - 8"

(4) Weight - 71 lb

e. Descriptive photographs and assembly cross section of the test item are furnished on pages C.1 through C.7, annex C.

TEST NO 2 - TRAINING REQUIREMENTS

1. PURPOSE. To determine the training time required to make test personnel sufficiently familiar with the test equipment to operate it and perform 1st echelon maintenance.

2. METHOD.

a. After a complete general study of the test item, and USAERDL Technical (reference 2a) Report 1698-TR, personnel experienced in the operation of pumping units were given instruction and practical training in those areas considered necessary for operation and maintenance of the control units.

b. The need for training aids was determined.

3. RESULTS.

a. One hour of instruction, 1 hour of practical demonstration, and 6 hours of controlled operation under direction of project engineers were required for experienced pumping unit operators to become proficient with the operation and 1st echelon maintenance of the test item.

b. No training aids other than the technical report and the test item were required, however, an operator's manual should be provided (item 6, annex B).

TEST NO 3 - OPERATIONAL PERFORMANCE

1. PURPOSE. To determine whether the test item can adequately perform the functions for which it was designed.

2. METHOD.

a. The pump units with the test items mounted on them were operated through various cycles of starting, stopping, and prolonged periods of continuous operation under varying conditions of pipeline flow. (A typical pipeline pump station is shown in photograph C. 13, annex C.) Operators were questioned as to all phases of operation.

b. The differential pressure across each control was changed from time to time. Variations from these preset differential pressures were noted.

c. Hydrostatic pressure tests and tests under conditions of low ambient temperature were not conducted because the results of engineering tests were satisfactory.

3. RESULTS.

a. The test items failed to maintain a constant differential pressure within the allowable limits of 2-1/2-percent deviation. (See item 4, annex B.) The differential pressure during prolonged periods of operation varied up to an average of 15 percent. (See section II, in annex D.)

b. The test item did not reduce the normally required number of operating personnel in a multiunit pump station.

c. From 3 to 5 minutes were required to start a pump and put it on line. This is approximately the same length of "cut in" time that is required for manually controlled pump units.

d. When the control unit was actuated to put the pump on line, a very fast acceleration occurred, causing a surging effect in the line.

e. The test item did prevent the pump from operating when pipeline pressures were too high or too low.

f. The test item did prevent operation at high pressures when zero flow conditions existed due to pipeline restriction or blockage.

g. The check valves did not allow the hydraulic fluid to flow freely from the reservoir. (See item 3, annex B.)

h. The springs and housing of the low and high pressure cutoff adjustment screws became rusted making adjustment difficult. The units in Japan were operated on a beach in a salt water atmosphere. (See item 5, annex B.)

i. The fast idle stop was found to be too long and caused the engine to idle at approximately 1,400 rpm during the warmup period. (See item 7, annex B.)

j. The hydraulic hand pump handle was too long and hit the side panel of the engine. (See item 8, annex B.)

k. The adjustment of the low suction pressure and high discharge pressure cutoff points could only be accomplished by a trial and error method. (See item 10, annex B.)

TEST NO 4 - COMPATIBILITY WITH RELATED EQUIPMENT

1. PURPOSE. To determine the compatibility of the test item with related equipment.

2. METHOD. The test items were mounted on pumps manufactured by Peerless Pump Company and Consolidated Manufacturing Company, both standard items in the supply system. Difficulties encountered and modifications required were noted.

3. RESULTS.

a. On the pump units fabricated by Peerless Pump Company, the voltage regulator and the reverse current overload switch had to be relocated to allow installation of the test item. (See page C.11, annex C.)

b. On the pump units fabricated by Consolidated Manufacturing Company the oil bath type air cleaner had to be relocated to allow installation of the control unit. (See page C.12, annex C.)

TEST NO 5 - MAINTENANCE

1. PURPOSE.

a. To determine whether organizational maintenance of the test item can be accomplished readily.

b. To accumulate data pertaining to man-hours expended in maintenance.

2. METHOD. Observations were made during maintenance operations to determine whether any operations were unduly difficult, required excessive time, or revealed design deficiencies prejudicial to ease of maintenance.

3. RESULTS. Repair of the test item at organizational level is not authorized and in the event of failure the entire unit is replaced. Therefore, maintenance was limited to 1st echelon and unit replacement.

a. Man-hours expended in maintenance consisted of the following:

(1) The time expended for daily 1st echelon maintenance averaged 1/10 man-hour per unit.

(2) Replacement of a test item required 1 man-hour.

b. Total man-hours of maintenance amounted to the following:

(1) 1st echelon - 14 man-hours

(2) Replacement - 3 man-hours

c. The drain plug for the bellows housing was not easily accessible when the control unit was mounted on the pump. (See item 9, annex B.)

TEST NO 6 - DURABILITY

1. PURPOSE. To determine whether the test item is durable.

2. METHOD. The 19 test items were operated for a total of 1,182 hours.

3. RESULTS.

a. Leaks developed around the suction pressure cutoff adjustment on top of the control units. (See item 2, annex B.)

(1) Five units failed or were withdrawn from the test due to excessive leakage with less than 50 hours of operating time each.

(2) Eight units failed or were withdrawn from the test due to excessive leakage with 50 to 75 hours of operating time each.

(3) Three units failed or were withdrawn from the test due to excessive leakage with 75 to 100 hours of operating time each.

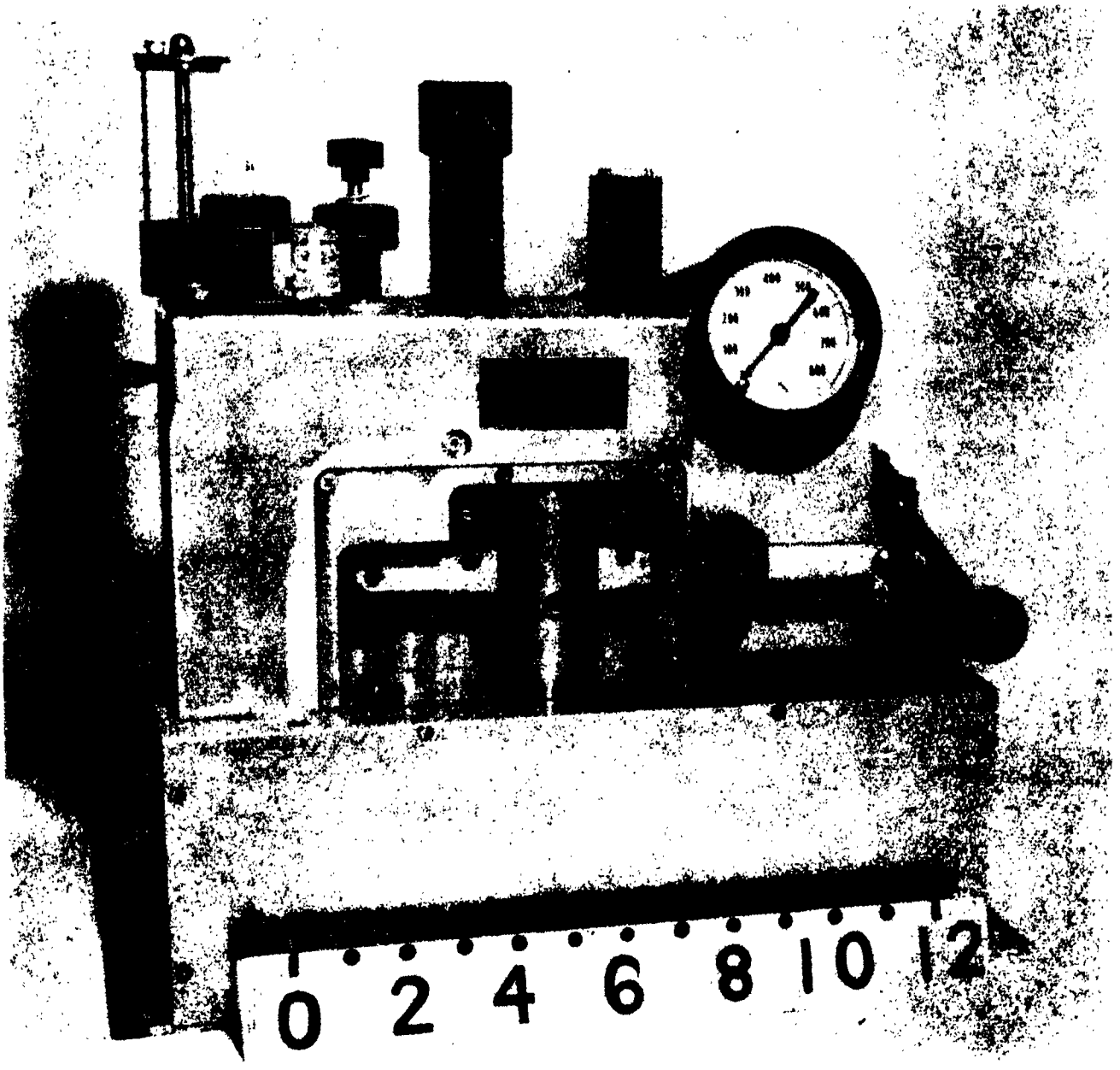
b. Three of the above units also leaked around the suction and discharge pressure bellows. (See item 1, annex B.)

ANNEX B

FINDINGS

EQUIPMENT FAULT	SUGGESTED CORRECTIVE ACTION	REMARKS
SECTION I		
This section contains deficiencies requiring elimination in order to make the item acceptable for use on a minimum basis.		
1. The suction and discharge bellows of three control units developed leaks.	Redesign the bellows using a more adaptable material.	
2. All control units leaked around the low suction pressure cutoff adjustment valve.	Redesign the low suction pressure cutoff assembly to eliminate this condition.	See pages C.7 and C.9, annex C.
3. The spring-loaded check valves on the control units do not allow the fluid to flow freely from the reservoir.	Replace the present check valves with non-spring-loaded type.	See page C.2, annex C.
4. Some control units did not maintain accuracy of ±2-1/2% on the differential pressure.	Redesign the controller unit so that an accuracy of ±2-1/2% can be maintained.	None.
5. The springs and housing of the low and high pressure cutoff adjustment screws became rusted making adjustment difficult.	Make the springs and housings from a rust resistant material.	Items T and U, page C.7, annex C.
6. An Operations and Maintenance Manual was not furnished with the unit.	Issue an Operations and Maintenance Manual with the control unit.	None.

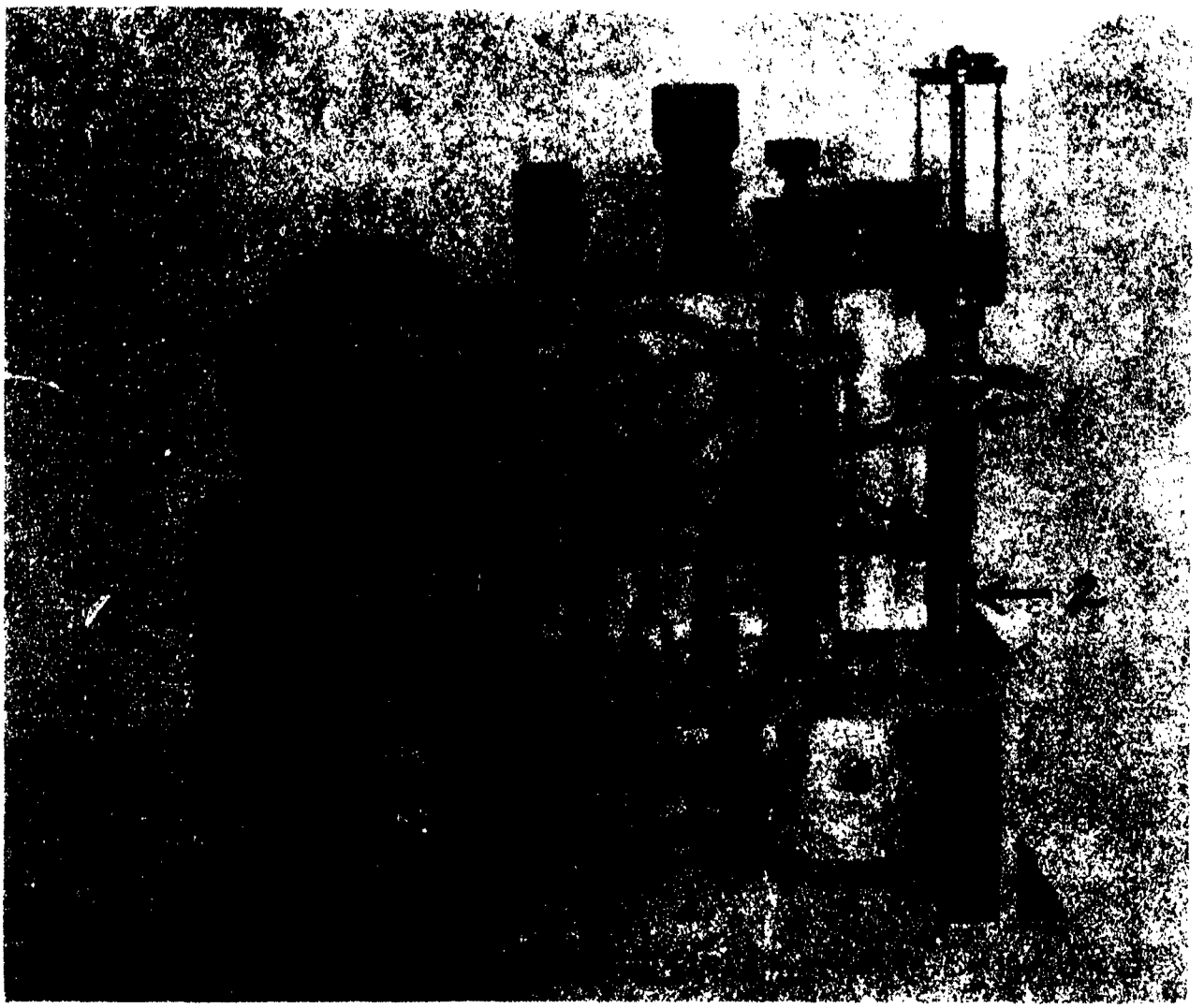
EQUIPMENT FAULT	SUGGESTED CORRECTIVE ACTION	REMARKS
SECTION II		
This section lists those equipment faults of the item which were discovered during test and satisfactorily corrected prior to completion of the test. They no longer represent a defect in the item tested. The correction must be applied to the production model of this item.		
Not Used		
SECTION III		
This section contains shortcomings which should be corrected, if it can be done without unduly complicating the item or inducing another undesirable characteristic, either concurrently with elimination of deficiencies in section I, in production engineering, or by product improvement.		
7. The existing fast-idle stop is too long and causes the engine to idle at approximately 1,400 rpm during warmup period.	Shorten the fast-idle stop to allow the engine to idle at approximately 900 rpm.	See item K, page C.7, annex C.
8. The hydraulic hand pump handle is too long and hits the side panel of engine.	Shorten the handle so as not to extend beyond the side of the control unit.	See page C.10, annex C.
9. The drain plug for the bellows housing is not easily accessible when the control unit is mounted on the pump.	Move the drain plug to the front of the bellows housing where it can be easily reached by removing the front cover plate.	See pages C.3 and C.7, annex C.
10. The adjustment of the low suction pressure and high discharge pressure cutoff points is at present a trial and error method.	Redesign the system to include a visually calibrated scale.	See page C.9, annex C.
11. The plug valve is easily broken off at the base during shipment of the control unit.	Brace the reservoir and plug valve assembly to the main body of the control unit or provide for removal during shipment.	See page C.2, annex C.



UNITED STATES ARMY ARMOR BOARD P-7D-3255-01 PHOTO NO 63-14 FT KNOX, KY

DIFFERENTIAL PRESSURE CONTROLLER FOR PIPELINE PUMP UNITS

FRONT OF TEST ITEM

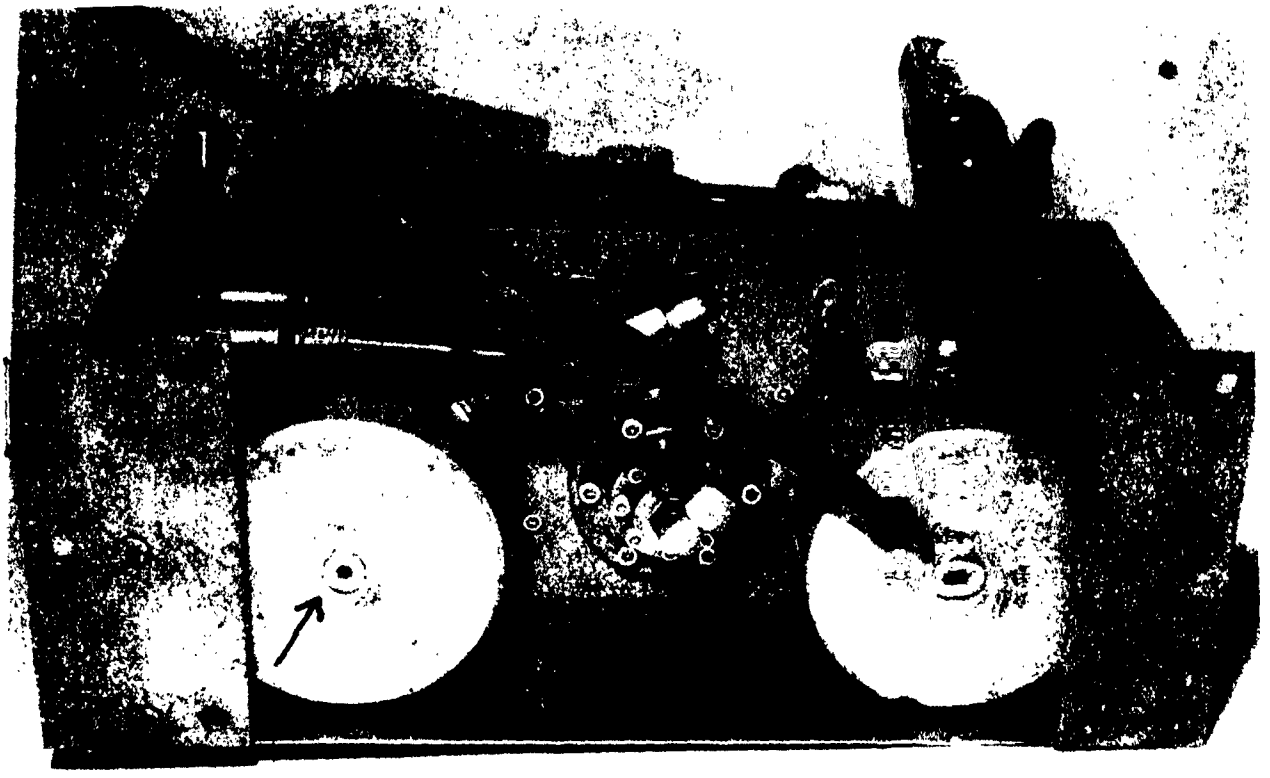


US ARMY ARMOR BOARD FORT KNOX, KY	USATECOM PROJ NO 7D-3255-01 PHOTO NO 63-11

DIFFERENTIAL PRESSURE CONTROLLER FOR PIPELINE PUMP UNITS

REAR OF TEST ITEM

1. PLUG VALVE. ARROW INDICATES POINT OF BREAKAGE.
2. SPRING-LOADED CHECK VALVES THAT OBSTRUCT FREE FLOW FROM RESERVOIR.



UNITED STATES ARMY ARMOR BOARD P-7D-3255-01 PHOTO NO. 63-13 FT KNOX, KY

DIFFERENTIAL PRESSURE CONTROLLER FOR PIPELINE PUMP UNITS

BOTTOM OF TEST ITEM. NOTE BELLOWS HOUSINGS AND DRAIN PLUGS.

UNITED STATES ARMY ARMOR BOARD P7D-3255-01 PHOTO NO 63-15 FT KNOX, KY

DIFFERENTIAL PRESSURE CONTROLLER FOR PIPELINE PUMP UNITS

NOTE: LINKAGE BETWEEN TEST ITEM AND CARBURETOR WAS NOT PROVIDED WITH THE UNIT. (ARROW)

UNITED STATES ARMY ARMOR BOARD P-7D-3255-01 PHOTO NO 63-12 FT KNOX, KY

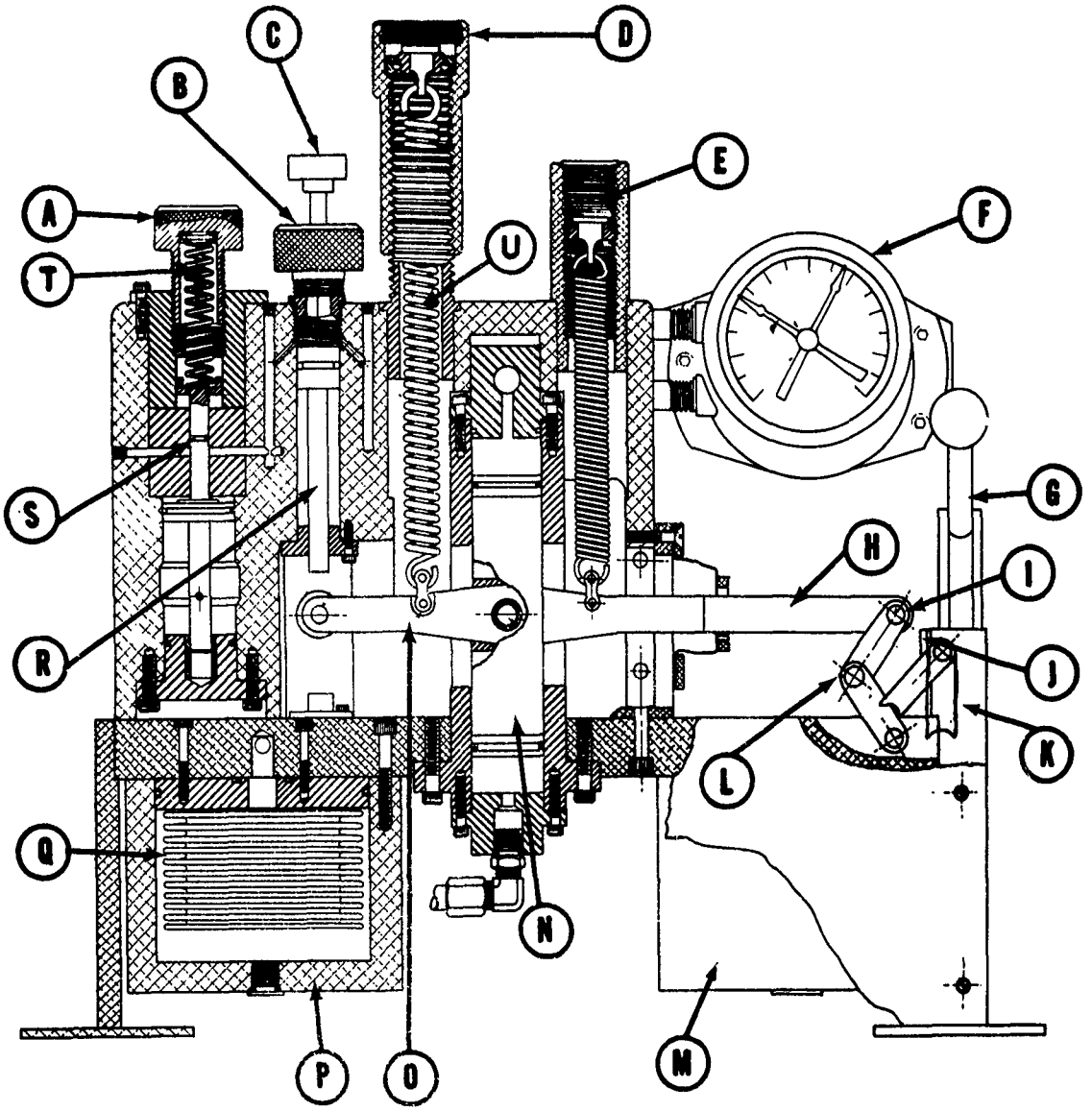
DIFFERENTIAL PRESSURE CONTROLLER FOR PIPELINE PUMP UNITS

JUNCTION OF SUCTION LINE, VERTICAL LINE (1) GOING UP TO PUMP SUCTION GAGE AND VERTICAL LINE (2) GOING DOWN TO CONTROL UNIT.

UNITED STATES ARMY ARMOR BOARD P-7D-3255-01 PHOTO NO 63-21 FT KNOX, KY

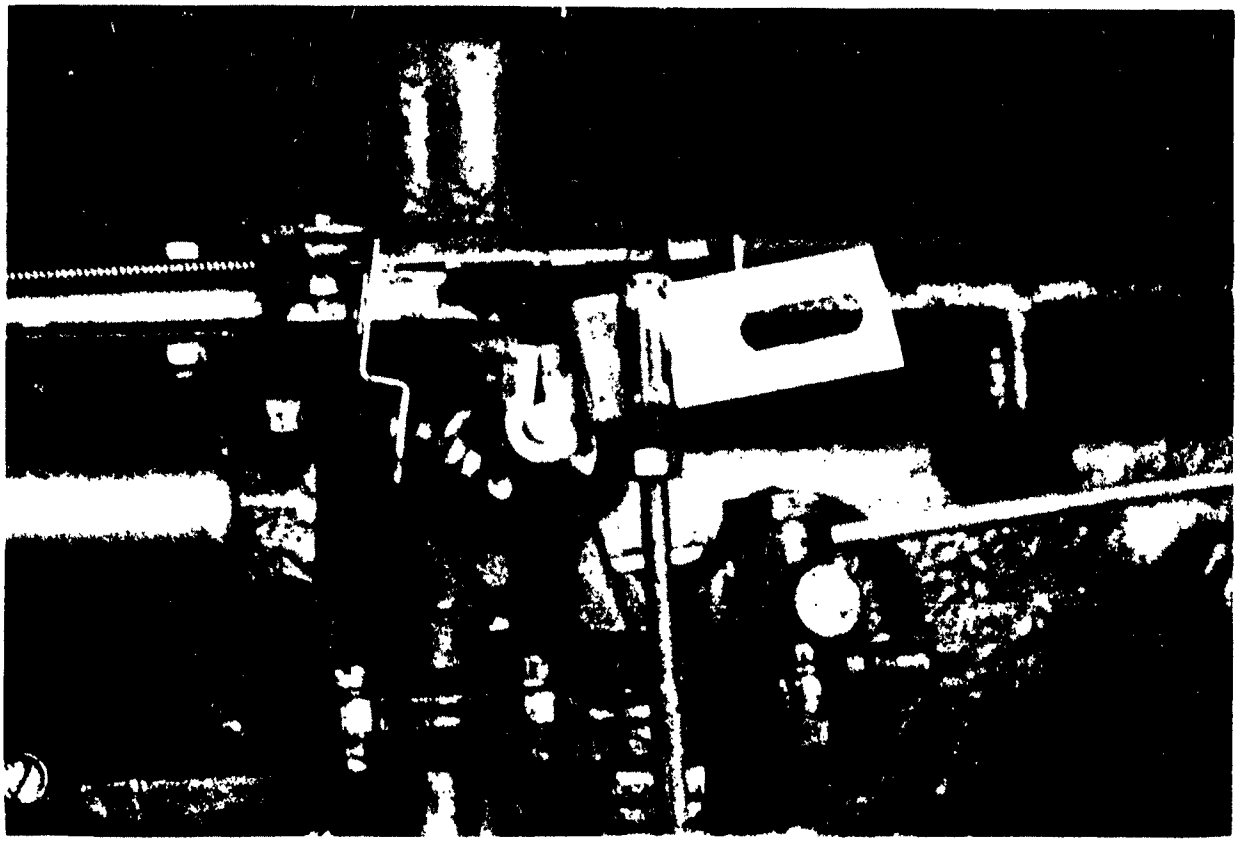
DIFFERENTIAL PRESSURE CONTROLLER FOR PIPELINE PUMP UNITS

DISCHARGE LINE OF CONTROL UNIT CONNECTING WITH CONTROL LINE GOING TO DISCHARGE GAGE OF PUMP UNIT.



DIFFERENTIAL-PRESSURE CONTROLLER FOR PIPELINE PUMP UNITS

ASSEMBLY CROSS SECTION OF DIFFERENTIAL PRESSURE CONTROLLER: (A) SUCTION PRESSURE CUTOFF ADJUSTMENT; (B) DISCHARGE PRESSURE CUTOFF ADJUSTMENT; (C) MANUAL HOLD-DOWN BUTTON; (D) DIFFERENTIAL PRESSURE ADJUSTMENT; (E) FIXED SPRING ADJUSTMENT; (F) DIFFERENTIAL PRESSURE GAGE; (G) HAND PUMP; (H) BEAM; (I) CARBURETOR CONNECTING ROD CONTACT POINT; (J) MAGNET; (K) FAST IDLE STOP; (L) RESET PIN; (M) DISCHARGE BELLOWS HOUSING; (N) DIFFERENTIAL PISTON; (O) BEAM; (P) SUCTION BELLOWS HOUSING; (Q) SUCTION BELLOWS; (R) EMERGENCY PISTON; (S) ORIFICE; (T) CUTOFF ADJUSTMENT SPRING; (U) DIFFERENTIAL PRESSURE ADJUSTMENT SPRING.



UNITED STATES ARMY ARMOR BOARD P-7D-3255-01 PHOTO NO 63-16 FT KNOX, KY

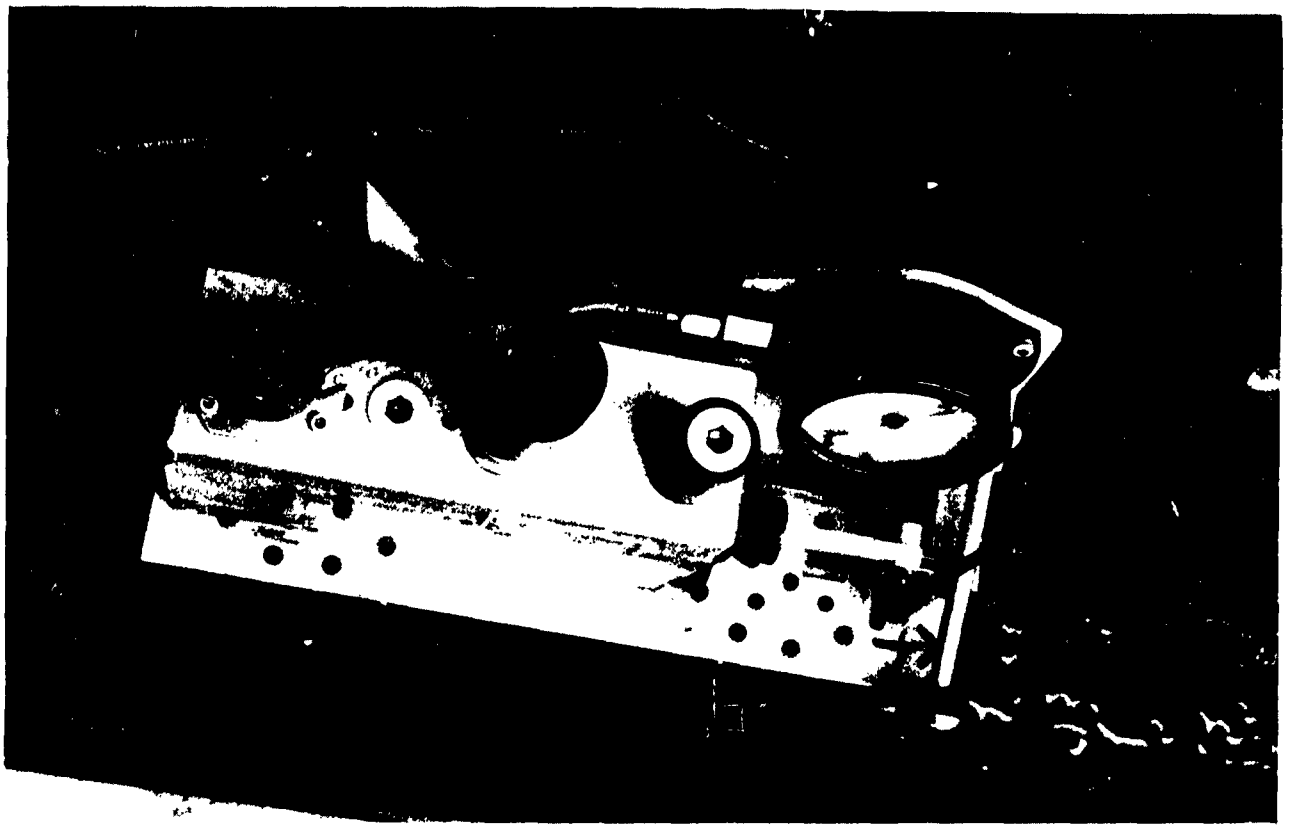
DIFFERENTIAL PRESSURE CONTROLLER FOR PIPELINE PUMP UNITS

CARBURETOR CONNECTING ARM FABRICATED LOCALLY

UNITED STATES ARMY ARMOR BOARD P-7D-3255-01 PHOTO NO 63-22 FT KNOX, KY

DIFFERENTIAL PRESSURE CONTROLLER FOR PIPELINE PUMP UNITS

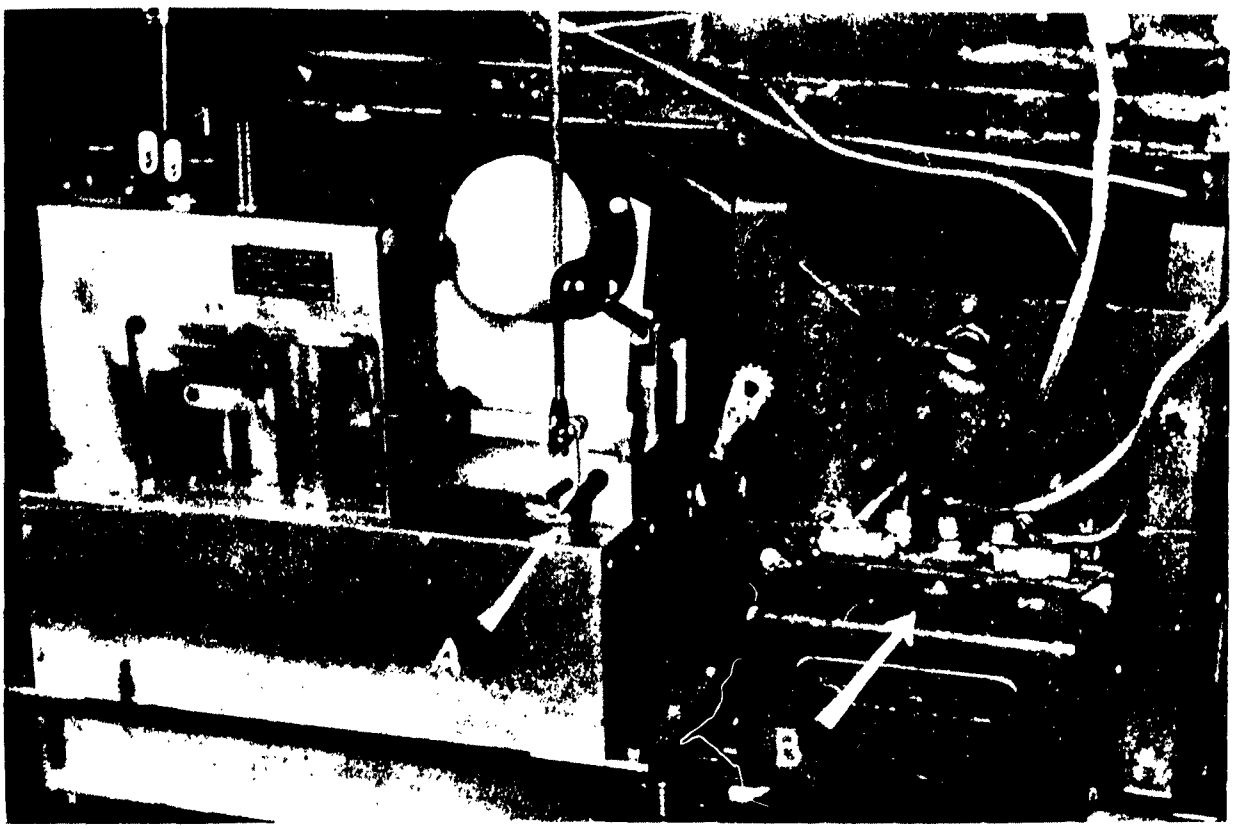
ALIGNMENT OF LINES ON ADJUSTMENT KNOB (ARROW A) AND PRESSURE SETTING INDICATOR (ARROW B) IS PROPER SETTING WHICH IS OBTAINED BY TURNING THE ADJUSTMENT KNOB. HYDRAULIC FLUID LEAKS OCCURRED AT POINTS "C" AND "D" ON ALL TEST ITEMS. NOTE RUST AROUND PRESSURE SETTING INDICATOR.



UNITED STATES ARMY ARMOR BOARD P-7D-3255-01 PHOTO NO 63-19 FT KNOX, KY

DIFFERENTIAL PRESSURE CONTROLLER FOR PIPELINE PUMP UNITS

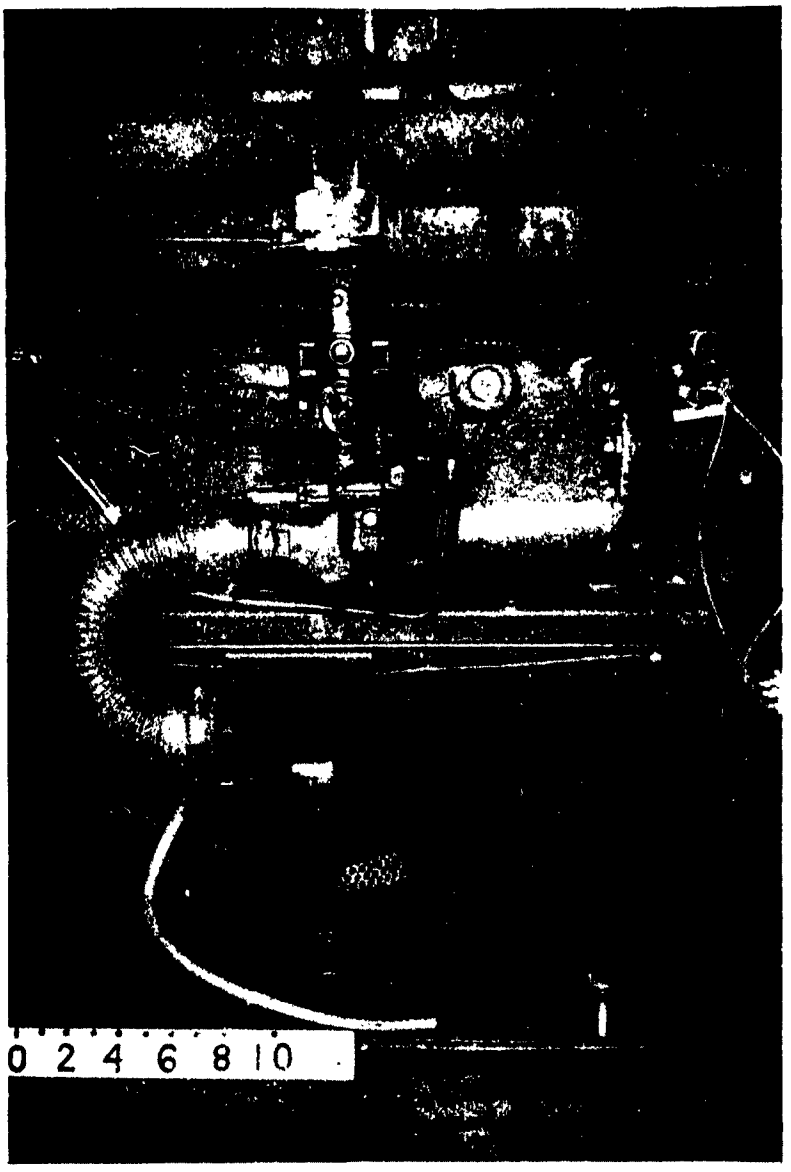
TEST ITEM MOUNTED ON PUMP. NOTE EXCESSIVE LENGTH OF HANDLE. (ARROW)



UNITED STATES ARMY ARMOR BOARD P-7D-3255-01 PHOTO NO 63-17 FT KNOX, KY

DIFFERENTIAL PRESSURE CONTROLLER FOR PIPELINE PUMP UNITS

MOUNTING OF TEST ITEM ON PEERLESS MANUFACTURING COMPANY PUMP NECESSITATED MOVING VOLTAGE REGULATOR FROM POINT "A" TO POINT "B".



UNITED STATES ARMY ARMOR BOARD P-7D-3255-01 PHOTO NO 63-18 FT KNOX, KY

DIFFERENTIAL PRESSURE CONTROLLER FOR PIPELINE PUMP UNITS

PUMP FABRICATED BY CONSOLIDATED MANUFACTURING COMPANY. NOTE AIR CLEANER THAT MUST BE RELOCATED TO ALLOW INSTALLATION OF CONTROL UNIT.

UNITED STATES ARMY ARMOR BOARD P-7D-3255-01 PHOTO NO 63-20 FT KNOX, KY

DIFFERENTIAL PRESSURE CONTROLLER FOR PIPELINE PUMP UNITS

TYPICAL MULTIUNIT PIPELINE PUMP STATION

DIFFERENTIAL PRESSURE CONTROLLER
FOR
PIPELINE PUMP UNIT

ANNEX D - SPECIAL RECORDS
SECTION I - OPERATIONS LOG - TOTAL HOURS FOR PROJECT

DATE	OPERATIONAL HOURS ACCUMULATED TODAY	TOTAL	LOCATION OF TESTING	REMARKS
15 Feb 62	15	15	Fort Lee, Virginia	1 operation hour = 1 hour on 1 unit
5 Mar 62	42	57	Fort Lee, Virginia	
6 Mar 62	90	147	Fort Lee, Virginia	
7 Mar 62	132	279	Fort Lee, Virginia	
8 Mar 62	144	423	Fort Lee, Virginia	
9 Mar 62	54	477	Fort Lee, Virginia	
30 Mar 62	8	485	Fort Lee, Virginia	
6 Jul 62	16	16	Hachinohe-Misawa, Japan	
7 Jul 62	18	34	Hachinohe-Misawa, Japan	
25 Jul 62	53	87	Hachinohe-Misawa, Japan	
26 Jul 62	16	103	Hachinohe-Misawa, Japan	
29 Jul 62	18	121	Hachinohe-Misawa, Japan	
30 Jul 62	77	198	Hachinohe-Misawa, Japan	
7 Aug 62	52	250	Hachinohe-Misawa, Japan	
8 Aug 62	96	346	Hachinohe-Misawa, Japan	
9 Aug 62	68	414	Hachinohe-Misawa, Japan	
15 Aug 62	11	425	Hachinohe-Misawa, Japan	
16 Aug 62	68	493	Hachinohe-Misawa, Japan	
17 Aug 62	92	585	Hachinohe-Misawa, Japan	
20 Aug 62	36	621	Hachinohe-Misawa, Japan	
21 Aug 62	76	697	Hachinohe-Misawa, Japan	

ANNEX D - SPECIAL RECORDS

SECTION II - OPERATIONS LOG FOR CONTROL UNITS I - II

Date	Average Differential Pressure (psi)	Variation In Differential Pressure (psi)	Hours Of Operation Today	Hours Of Operation Total	Remarks
Control Unit Nr. 1					
7 Aug 62	190	0	8	8	Pumping JP-4. Leaking fluid.
8 Aug 62	190	0	8	16	Pumping JP-4. Leaking fluid.
9 Aug 62	190	10	14	30	Pumping Diesel. Leaking fluid.
16 Aug 62	180	10	13	43	Pumping JP-4. Leaking fluid.
17 Aug 62	180	10	6	49	Pumping JP-4. Leaking fluid.
21 Aug 62	190	10	15	64	Pumping JP-4. Leaking fluid.
Control Unit Nr. 2					
16 Aug 62	180	0	6	6	Pumping JP-4. Leaking fluid.
17 Aug 62	200	20	23	29	Pumping JP-4. Leaking fluid.
20 Aug 62	170	20	11	40	Pumping JP-4. Leaking fluid.
21 Aug 62	150	0	4	44	Pumping JP-4. Leaking fluid.
Control Unit Nr. 3					
6 Jul 62	210	10	8	8	Pumping JP-4. Leaking fluid.
7 Jul 62	220	20	6	14	Pumping JP-4. Leaking fluid.
25 Jul 62	220	20	14	28	Pumping JP-4. Leaking fluid.
29 Jul 62	220	30	5	33	Pumping JP-4. Leaking fluid.
30 Jul 62	200	0	1	34	Pumping JP-4. Leaking fluid.
7 Aug 62	210	0	8	42	Pumping JP-4. Leaking fluid.
8 Aug 62	220	0	8	50	Pumping JP-4. Leaking fluid.
9 Aug 62	210	0	14	64	Pumping Diesel. Leaking fluid.
16 Aug 62	180	10	13	77	Pumping JP-4. Leaking fluid.
17 Aug 62	210	0	6	83	Pumping JP-4. Leaking fluid.
21 Aug 62	160	20	8	91	Pumping JP-4. Leaking fluid.
Control Unit Nr. 4					
6 Jul 62	190	10	8	8	Pumping JP-4. Leaking fluid.
7 Jul 62	190	10	6	14	Pumping JP-4. Leaking fluid.
25 Jul 62	190	10	8	22	Pumping JP-4. Leaking fluid.
26 Jul 62	200	10	4	26	Pumping JP-4. Leaking fluid.

Date	Average Differential Pressure (psi)	Variation In Differential Pressure (psi)	Hours Of Operation Today	Hours Of Operation Total	Remarks
Control Unit Nr. 4 (Cont'd)					
29 Jul 62	210	30	5	31	Added 1/2 reservoir full of fluid.
30 Jul 62	200	20	12	43	Pumping JP-4. Leaking fluid. Replaced by Control Nr. 1.
Control Unit Nr. 5					
30 Jul 62	180	10	12	12	Pumping JP-4. Leaking fluid.
7 Aug 62	200	10	5	17	Pumping JP-4. Leaking fluid.
8 Aug 62	170	20	16	33	Pumping JP-4. Leaking fluid.
9 Aug 62	200	0	8	41	Pumping Diesel. Leaking fluid.
15 Aug 62	190	10	3	44	Pumping JP-4. Leaking fluid. Control Unit replaced by Control Nr. 7.
Control Unit Nr. 6					
25 Jul 62	190	10	6	6	Pumping JP-4. Leaking fluid.
26 Jul 62	200	10	4	10	Pumping JP-4. Leaking fluid.
30 Jul 62	180	0	15	25	Pumping JP-4. Leaking fluid.
7 Aug 62	190	0	5	30	Pumping JP-4. Leaking fluid.
8 Aug 62	200	0	16	46	Pumping JP-4. Leaking fluid.
9 Aug 62	200	30	8	54	Pumping Diesel. Leaking fluid.
15 Aug 62	200	10	3	57	Pumping JP-4. Leaking fluid.
16 Aug 62	190	0	6	63	Pumping JP-4. Leaking fluid.
17 Aug 62	180	10	9	72	Pumping JP-4. Leaking fluid.
20 Aug 62	200	10	11	83	Pumping JP-4. Leaking fluid.
21 Aug 62	200	0	4	87	Pumping JP-4. Leaking fluid.
Control Unit Nr. 7					
16 Aug 62	190	20	5	5	Control Nr. 7 replaced by Control Nr. 9
17 Aug 62	180	10	8	13	Pumping JP-4. Leaking fluid.
20 Aug 62	180	10	6	19	Pumping JP-4. Leaking fluid.
21 Aug 62	180	10	20	39	Pumping JP-4. Leaking fluid.

Date	Average Differential Pressure (psi)	Variation In Differential Pressure (psi)	Hours Of Operation Today	Hours Of Operation Total	Remarks
Control Unit Nr. 8					
25 Jul 62	190	10	8	8	Pumping JP-4. Leaking fluid.
29 Jul 62	190	10	4	12	Pumping JP-4. Leaking fluid.
30 Jul 62	190	10	8	20	Pumping JP-4. Leaking fluid.
7 Aug 62	190	0	5	25	Pumping JP-4. Leaking fluid.
8 Aug 62	190	0	8	33	Pumping JP-4. Leaking fluid.
9 Aug 62	210	0	10	43	Pumping Diesel. Leaking fluid.
15 Aug 62	190	0	3	46	Pumping JP-4. Leaking fluid.
16 Aug 62	190	0	6	49	Pumping JP-4. Leaking fluid.
17 Aug 62	190	10	15	64	Pumping JP-4. Leaking fluid.
21 Aug 62	190	10	7	71	Pumping JP-4. Leaking fluid.
Control Unit Nr. 9					
7 Jul 62	200	0	3	3	Pumping JP-4. Leaking fluid.
25 Jul 62	190	0	5	8	Pumping JP-4. Leaking fluid.
26 Jul 62	190	0	4	12	Pumping JP-4. Leaking fluid.
30 Jul 62	170	60	11	23	Pumping JP-4. Leaking fluid.
7 Aug 62	190	10	8	31	Pumping JP-4. Leaking fluid.
3 Aug 62	200-40	160	10	41	Differential Pressure decreased 160 lbs over a period of 10 hours.
9 Aug 62					Control was replaced.
Control Unit Nr. 10					
25 Jul 62	200	10	8	8	Pumping JP-4. Leaking fluid.
29 Jul 62	210	10	4	12	Pumping JP-4. Leaking fluid.
30 Jul 62	200	10	8	20	Pumping JP-4. Leaking fluid.
7 Aug 62	200	0	5	25	Pumping JP-4. Leaking fluid.
8 Aug 62	200	0	8	33	Pumping JP-4. Leaking fluid.
9 Aug 62	200	10	6	39	Pumping Diesel. Leaking fluid.
15 Aug 62	200	10	3	42	Pumping JP-4. Leaking fluid.
16 Aug 62	200	10	6	48	Pumping JP-4. Leaking fluid.
17 Aug 62	200	10	15	63	Pumping JP-4. Leaking fluid.

Date	Average Differential Pressure (psi)	Variation In Differential Pressure (psi)	Hours Of Operation Today	Hours Of Operation Total	Remarks
Control Unit Nr. 11					
7 Jul 62	190	10	3	3	Pumping JP-4. Leaking fluid.
25 Jul 62	200	10	5	8	Pumping JP-4. Leaking fluid.
26 Jul 62	210	5	4	12	Pumping JP-4. Leaking fluid.
30 Jul 62	210	10	11	23	Pumping JP-4. Leaking fluid.
7 Aug 62	200	10	8	31	Pumping JP-4. Leaking fluid.
8 Aug 62	200	0	12	43	Pumping JP-4. Leaking fluid.
9 Aug 62	200	0	13	56	Pumping JP-4. Leaking fluid.
16 Aug 62	210	10	13	69	Pumping JP-4. Leaking fluid.
17 Aug 62	200	0	8	77	Pumping JP-4. Leaking fluid.
20 Aug 62	200	10	8	85	Pumping JP-4. Leaking fluid.
21 Aug 62	200	10	12	97	Pumping JP-4. Leaking fluid.

ANNEX D - SPECIAL RECORDS
SECTION III - MAINTENANCE LOG

Date	Maintenance Performed	Quantity Required	Timed Req'd (Hours)	Number Of Men Req'd	Probable Cause of Failure
7 Aug 62	Replaced Control Unit 4 because of excessive leaking of fluid around suction cutoff adjustment valve.	1 Control Unit	1	1	Internal leakage in Unit
16 Aug 62	Replaced Control Unit Nr. 5 with Nr. 7 because of the malfunction of the Unit.	1 Control Unit	1	1	Unable to determine cause of failure
16 Aug 62	Replaced Control Nr. 9 because of malfunction	1 Control Unit	1	1	Unable to determine cause of failure.